

**TECHNIQUES FOR PROVIDING MULTIPLE ON-CHIP  
TERMINATION IMPEDANCE VALUES TO PINS ON AN  
INTEGRATED CIRCUIT**

5 **CROSS-REFERENCES TO RELATED APPLICATIONS**

QC [0001] This patent application is a continuation-in-part of U.S. patent application  
now US Patent, 6,798,237,  
10/044,365, filed January 11, 2002, which claims the benefit of U.S. provisional application  
60/315,965, filed August 29, 2001, both of which are incorporated by reference herein.

**BACKGROUND OF THE INVENTION**

10 [0002] The present invention relates to techniques for providing multiple on-chip  
termination impedance values to pins on an integrated circuit, and more particularly, to  
techniques for providing different termination impedance values to different pins on an  
integrated circuit using by shifting digital bit signals.

[0003] Prior art integrated circuits have off-chip termination resistors. An off-chip  
15 termination resistor is coupled to each input/output (I/O) pin of an integrated circuit to  
provide termination impedance. The impedance of each off-chip resistor matches the  
impedance of a transmission line coupled to the pin to reduce signal reflection.

[0004] Some integrated circuit have hundreds of I/O pins that require impedance matching  
circuitry. In these integrated circuits, a separate impedance matching resistor must be  
20 coupled to each of the I/O pins. Hundreds of impedance matching resistors must be coupled  
to such an integrated circuit to provide adequate impedance matching. Thus, prior art off-  
chip impedance matching resistors substantially increase the amount of board space required.

[0005] Other prior art integrated circuits have provided on-chip impedance termination  
techniques. However, these on-chip impedance termination techniques provide the same  
25 impedance termination values to one or more I/O pins on the integrated circuit.

[0006] Different I/O pins on an integrated circuit are typically coupled to different  
transmission lines that have different characteristic impedance values. Providing the same  
impedance termination values at each pin does not produce the right impedance matching  
values that are needed to reduce signal reflection on all of the transmission lines. Therefore,  
30 it would be desirable to have circuitry that can match the characteristic impedance of